REMARKS/ARGUMENTS

In the Office Action dated February 15, 2006, Claims 1-35 are pending, of which Claims 1-14 and 16-25 have been elected with traverse for prosecution. The remaining, non-elected claims are cancelled above, and Applicant expressly reserves the right to file divisional applications or take such other appropriate measures deemed necessary to protect the inventions in the remaining claims.

Claims 1-4 and 10-15 are rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 4,882,823 to Weisert, et al. in view of U.S. Patent No. 5,024,369 to Froes, et al. The remaining Claims 5-9 and 16-25 are rejected under § 103(a) as being unpatentable over Weisert, et al. in view of Froes, et al. and in view of U.S. Patent No. 5,118,026 to Stacher. In addition, the drawings are objected to, and one of the references cited in the Information Disclosure Statement was not considered.

First, regarding the Information Disclosure Statement, Applicant is submitting herewith another Information Disclosure Statement that again identifies the reference not previously considered, i.e., "Microstructure and Superplastic Properties at Room Temperature in Zn-22A1 Alloy after Equal-Channel-Angular Extrusion," and a copy is enclosed for the Examiner's review. Further, the Information Disclosure Statement identifies several patents noted in the text of the application. It appears from the Examiner's comments, that the Examiner may have already considered these patents, but Applicant is citing them on the Information Disclosure Statement for completeness.

With regard to the objection to the drawings, Applicant is submitting a replacement sheet for page 7/7, which includes Figures 6 and 7. The drawings have been amended to include the reference numerals 40, 42, 44, and 46 in Figure 6, as indicated in the present application at paragraph 0031. The Examiner's careful review and attention to the details of the application are noted with appreciation.

Turning now to the rejection of claims under § 103(a), Applicant respectfully traverses and requests reconsideration of the claims in light of the above amendments and the following remarks.

Claim 1, as amended, is directed to a method for superplastically forming a refined-grain titanium blank at a relatively low temperature to produce a structural member. In particular, the

method includes providing a blank, which comprises titanium and has a grain size between about 0.8 and 1.2 micron. The blank is heated and superplastically formed at a forming temperature of less than 1450 °F to produce the structural member having a predetermined configuration.

None of the cited references discloses a method of superplastically forming such a refined-grain titanium blank at a temperature of less than 1450 °F. Weisert, et al. does not disclose either the claimed grain size or temperature. In fact, as acknowledged in the Office Action, "Weisert lacks disclosure of specific grain sizes for the titanium blank" (Office Action, page 6) and teaches a temperature range of about "1450° F–1750° F, preferably, 1650° F–1750° F" (Weisert, et al. at col. 4, lines 15-19). Froes, et al. also fails to disclose the claimed grain size and temperature. In particular, Froes, et al. discloses a material with a grain size of "about 2 to 20 microns."

Previous Claim 3 recited a grain size of about 0.8-1.2 micron. The Office Action states:

> Regarding claims 3-4, Weisert lacks disclosure of specific grain sizes for the titanium blank. Froes discloses . . . an average grain size of about 2 to 20 microns (Froes, col. 4, lines 14-15). Put another way, Froes teaches "about 2 microns" to be an art recognized result effective variable depending on the type of material to be used. It would have been obvious to one having ordinary skill in the art at the time of the invention was made to modify the process of Weisert to include the grain size restraints of Froes in order to permit fabrication of airframe and engine structures with significant cost and weight reduction (Froes, col. 2, lines 6-8). That is it would have been obvious to one of ordinary skill in the art at the time of the invention to choose the instantly claimed ranges through process optimization, since it has been held that there are general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. See In re Boesch, 205 USPQ 215 (CCPA 1980).

Office Action, page 7.

Applicant disagrees. Froes, et al. describes conventional techniques for producing rapidly-solidified foil that is "about 10 to 100 microns thick, with an average beta grain size of about 2 to 20 microns, which is substantially smaller than the beta grain size produced by ingot metallurgy methods." According to Froes, et al. "[t]he requirements for multi-step and expensive thermomechanical processing for converting ingot material into sheetstock and foil having a desireable generally uniform and equiaxed grain structure are now unnecessary." Froes, et al. does not describe grain size as a "result effective variable" that depends on the type of material

to be used. Moreover, Froes, et al. does not teach or suggest the grain size as is now recited in Claim 1.

Further, it would not have been obvious to use the thin sheets of rapidly-solidified foil of Froes, et al. to form a structure having varying mass distribution as disclosed by Weisert, et al. Weisert, et al. discloses a method of using multiple sheets that have selected mass distributions. The selected mass distributions are achieved by providing each sheet with one flat surface and an opposite surface that is contoured according to the desired mass distribution of the final structure. *See, e.g.*, col. 4, lines 31-48. Neither Weisert, et al. nor Froes, et al. discloses that such surface contouring for achieving mass distribution can be achieved with rapidly-solidified foil that is about 10 to 100 millionths of an inch thick. Further, Weisert, et al. specifically teaches away from a process of achieving a mass distribution by cutting and stacking flat sheet stock, noting various problems such as difficulty in controlling the aggregate thickness of stacked sheets, voids created by the edges of sheet details, and buried weld nuggets. *See* col. 1, line 46 – col. 2, line 31.

Accordingly, the references cannot be combined fairly as suggested in the Office Action and, in any case, the references fail to disclose the features of the invention as set forth in Claim 1. Therefore, Claim 1 is patentable over the cited references, as are each of the various dependent claims.

Further, the dependent claims provide additional bases of distinction over the cited references. For example, Claims 11 and 12 also stand rejected on the sole basis of being unpatentable over Weisert, et al. in view of Froes, et al. Claim 11 recites "superplastically forming the blank at a strain rate of at least about 6×10^{-4} per second." Claim 12 recites that the strain rate is "at least about 1×10^{-3} per second." The Office Action does not point to any such teaching in the prior art references but rather merely states:

> Weisert also discloses that superplastic behavior enhances formability under compressive strain conditions (Weisert, col. 3, lines 47-49). Therefore, the properties and method of invention are so similar with that of the applicant's claimed invention it is necessarily present to arrive at the specified strain rates of claims 11 and 12.

Office Action, page 6.

The cited portion of Weisert, et al. states as follows:

> Superplasticity is the capability of a material to develop unusually high tensile elongation with reduced tendency toward local necking during deformation. Superplastic behavior also enhances formability under compressive strain conditions. However, this invention is particularly concerned with superplastic metals which are subject to contamination of surface integrity at forming temperatures.

Weisert, et al., col. 3, lines 44-51.

Weisert, et al. does not teach or suggest the strain rates set forth in Claims 11 and 12. Further, Applicant disagrees with the contention set forth in the Office Action that "it is necessarily present to arrive at the specified strain rates of claims 11 and 12." As noted in the present application, "workpieces formed of titanium alloys are typically superplastically formed in a temperature range between about 1450 °F and 1850 °F at a strain rate up to about 3×10^{-4} per second." Paragraph 0002. Since a higher strain rate would require higher pressures and/or result in higher stresses, it would not have been necessary or obvious to achieve the claimed strain rates using conventional materials, such as those used in the prior art references. Accordingly, Applicant respectfully submits that each of Claims 11 and 12 is patentable for this additional reason.

Independent Claim 16 stands rejected under § 103(a) as being unpatentable over Weisert, et al. in view of Froes, et al. and in view of Stacher. Claim 16 is also directed to a method for superplastically forming a blank to produce a structural member. The method includes providing a blank of Ti-6Al-4V with a grain size of about 0.8-1.2 micron, heating the blank, and superplastically forming the blank at a forming temperature of less than about 1450 °F. Further, as a result of the superplastic forming, a layer less than about 0.001 inch thick of alpha case oxide is formed on the surfaces of the structural member, and the structural member is pickled to remove the alpha case oxide layer.

As noted above, neither Weisert, et al. nor Froes, et al. disclose superplastically forming a titanium blank with the claimed grain size at the claimed temperature. Stacher also fails to disclose these features. Instead, Stacher teaches that "[f]or titanium aluminide, the temperature range in which superplasticity can be observed is about 1750° F. to about 1900° F." (col. 5, lines 15-17) and does not disclose any grain sizes.

Further, none of these references discloses the feature of forming an alpha case oxide layer that is less than about 0.001 inch thick during superplastic forming and removing the layer by pickling. In this regard, the Office Action states:

> The combined invention of Weisert and Froes does not disclose pickling the surface of the workpiece to remove any formed oxide during the superplastic forming step. Stacher discloses the fabrication of titanium aluminide sandwich structures that combines the process of metal joining and superplastic forming (Stacher, col. 3, lines 26-29). Stacher states that titanium is particularly sensitive to oxygen, nitrogen, and water vapor content in the air at elevated temperatures (Stacher, col. 2, lines 33-35). Stacher further teaches that the surfaces require preparatory cleaning (i.e., pickling) (Stacher, col. 2, lines 45-47) and states that further application of pressure breaks up the surface oxides to present clean surfaces for bonding (Stacher, col. 2, lines 53-55). Furthermore, Weisert's invention includes the same properties and method of the claimed invention. Thus, with the combined invention of Weisert, Froes, and Stacher it is obvious to arrive at the claimed pickling rate. It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the combined invention of Weisert and Froes to include the pickling step of Stacher in order to significantly lower the cost, difficulty, and time involved in diffusion bonding and superplastic forming titanium alloy structures (Stacher, col. 3, lines 30-36).

Office Action, page 11.

Applicant disagrees. Stacher refers to pickling solely for the purpose of preparatory cleaning before diffusion bonding. *See* col. 2, lines 39-65. Stacher does not disclose pickling after a superplastic forming operation. Further, Stacher does not disclose forming an alpha case layer during superplastic forming, or that the layer can be formed in a layer of the claimed thickness. To the contrary, Stacher states that a controlled environment must be provided when superplastic forming titanium aluminides to prevent it from becoming embrittled and its integrity destroyed, as would occur if the titanium aluminide is not protected. *See* col. 2, lines 30-38.

Accordingly, even in combination, the cited references fail to disclose the various features of the method set forth in Claim 16, i.e., that a layer of alpha case oxide is formed by the superplastic forming operation, that the layer is formed with a thickness of less than about 0.001 inch thick, or that the structural member is pickled to remove the alpha case oxide layer. Therefore, Applicant submits that Claim 16 is patentable over the cited references, as are each of the dependent claims.

Further, the dependent claims recite additional features that distinguish the cited references. For example, Claim 18 recites that the structural member is subjected to a pickling fluid, "thereby removing material from surfaces of the structural member at a rate less than about 5×10^{-5} inch per minute." Claim 19 recites that "less than about 0.001 inch" is removed from each surface of the structural member in the pickling step. The references do not disclose these features. Nor do the references disclose that the structural member can be superplastically formed at a temperature of about 1425 °F, as recited in Claim 21.

New independent Claim 36 is also directed to a method of superplastically forming a blank and includes several of the above-described features, which are not disclosed by the cited references. In particular Claim 36 recites that the blank is formed of Ti-6Al-4V with a grain size of between about 0.8 and 1.2 micron, and the blank is superplastically formed at a temperature of less than about 1450 °F and at a strain rate of at least about 6×10^{-4} per second. As the cited references, even in fair combination, fail to disclose these features, it is respectfully submitted that Claim 36 is patentable, as are each of the dependent Claims 37-44, which recite features previously set forth in other claims.

For the reasons set forth above, Applicant submits that each of Claims 1, 2, 4-14, 16-25, and 36-44 is now allowable.

* * * *

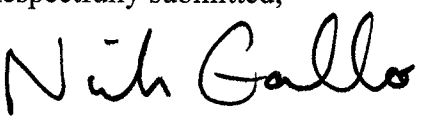
CONCLUSIONS

In view of the remarks presented above, Applicant submits that the present application is in condition for allowance. As such, the issuance of a Notice of Allowance is therefore respectfully requested. In order to expedite the examination of the present application, the Examiner is encouraged to contact Applicant's undersigned attorney in order to resolve any remaining issues.

It is not believed that extensions of time or fees for net addition of claims are required, beyond those that may otherwise be provided for in documents accompanying this paper. However, in the event that additional extensions of time are necessary to allow consideration of this paper, such extensions are hereby petitioned under 37 CFR § 1.136(a), and any fee required

therefore (including fees for net addition of claims) is hereby authorized to be charged to Deposit Account No. 16-0605.

Respectfully submitted,



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